FINAL SUBMITTAL

ENERGY ENGINEERING ANALYSIS PROGRAM

LIMITED ENERGY STUDY

WATERVLIET ARSENAL

WATERVLIET, NEW YORK

EXECUTIVE SUMMARY

CONTRACT NO. DACA65-91-C-0072

PREPARED FOR:

U.S. ARMY CORPS OF ENGINEERS
NORFOLK, VIRGINIA

PREPARED BY:

REYNOLDS, SMITH AND HILLS, INC.
ENERGY AND ENVIRONMENTAL SERVICES DEPARTMENT
P.O. BOX 4850
JACKSONVILLE, FLORIDA 32201

PROJECT NO. 2900379002

AUGUST 1992

DEPARTMENT OF THE ARMY
CONSTRUCTION ENGINEERING RESEARCH LABORATORIES, CORPS OF ENGINEERS
P.O. BOX 9005
CchampaIGN, ILLINOIS 61826-9005

REPLY TO
ATTENTION OF: TR-I Library

17 Sep 1997

Based on SOW, these Energy Studies are unclassified/unlimited.
Distribution A. Approved for public release.

Marie Wakefield,
Librarian Engineering

TABLE OF CONTENTS

EXECUTIVE SUMMARY

1.0 INTRODUCTION

1.1 Authorization

The Energy Engineering Analysis Program (EEAP), Limited Energy Study (LES), Watervliet Arsenal (WVA), Watervliet, New York was authorized by the Department of the Army, Norfolk District Corps of Engineers, under Contract Number DACA65-91-C-0072.

1.2 Objectives

The objectives of this contract, as explained in the Detailed Scope of Work (Appendix A in Volume II) of the contract are as follows:

A. Review, use and incorporate applicable data and results of the previously completed Energy Engineering Analysis Program study.

B. Perform a limited site audit and analysis of the industrial facility.

C. Re-evaluate specific projects or ECOs from the previous study to determine its economic feasibility based on revised criteria, current site conditions and technical applicability. However, no previously identified process energy-related projects or ECOs were selected by Watervliet Arsenal.

D. Evaluate specific ECOs to determine their energy savings potential and economic feasibility as indicated in the Appendix of the Scope of Work.

E. Prepare programming and implementation documentation for all justifiable ECOs.

F. Prepare a comprehensive report which will document the work accomplished, the results and the recommendations.

1.3 Report Organization

The report consists of six volumes. Volume I, the Narrative Report, contains the results of all of the site surveys, analysis and project development. All backup data and calculations are found in Volume II. The site survey notes are in Volumes III (Production Facilities) and IIIa (Ancillary Facilities), and project documentation forms necessary for receiving funding are in Volume IV. Also included is an Executive Summary volume.

2.0 INSTALLATION DESCRIPTION

Watervliet Arsenal (WVA) is a government-owned, government-operated (GOGO) production facility under AMC direction. The Arsenal's mission is to manufacture cannons, special tools, test equipment, and training devices needed to support large caliber weapons. The facility is equipped to produce cannons with bore diameters from 20mm to 16 inches. WVA is also the home of Benet Weapons Laboratory, active in weapons-related research, development and processes. The installation site plan is contained in Figure 2-1.

There are 80 buildings at the Arsenal, representing over two million square feet of space. Most buildings are dedicated to manufacturing and administration.

2.1 Production Facilities

The basic process flow diagram between the buildings surveyed are shown in Figure 2-2. The raw materials for making the major gun tube components, minor gun tube components, other components, and gun tubes are brought to Buildings 20, 25, 125 and 135, respectively. Building 35 receives the gun tube and other components in a rough form, and various other machining operations as well as plating are performed here. The final step in the process is performed in Building 110 where the assemblies are painted, preserved and packaged for shipment. These buildings represent about 1.2 million square feet or 60 percent of the installation total.

2.2 Ancillary Facilities

Ancillary facilities are defined here as non-production buildings. This includes administration, laboratories and support services as well as other non-energy-intensive buildings. All of these buildings are masonry typically utilizing a dark red brick. Since WVA began in 1814, there are many buildings of historical interest. All buildings surveyed, except Building 145, are heated via steam from the main boiler plant, Building 136. Ancillary facilities have a total floor space of about 900,000 square feet.

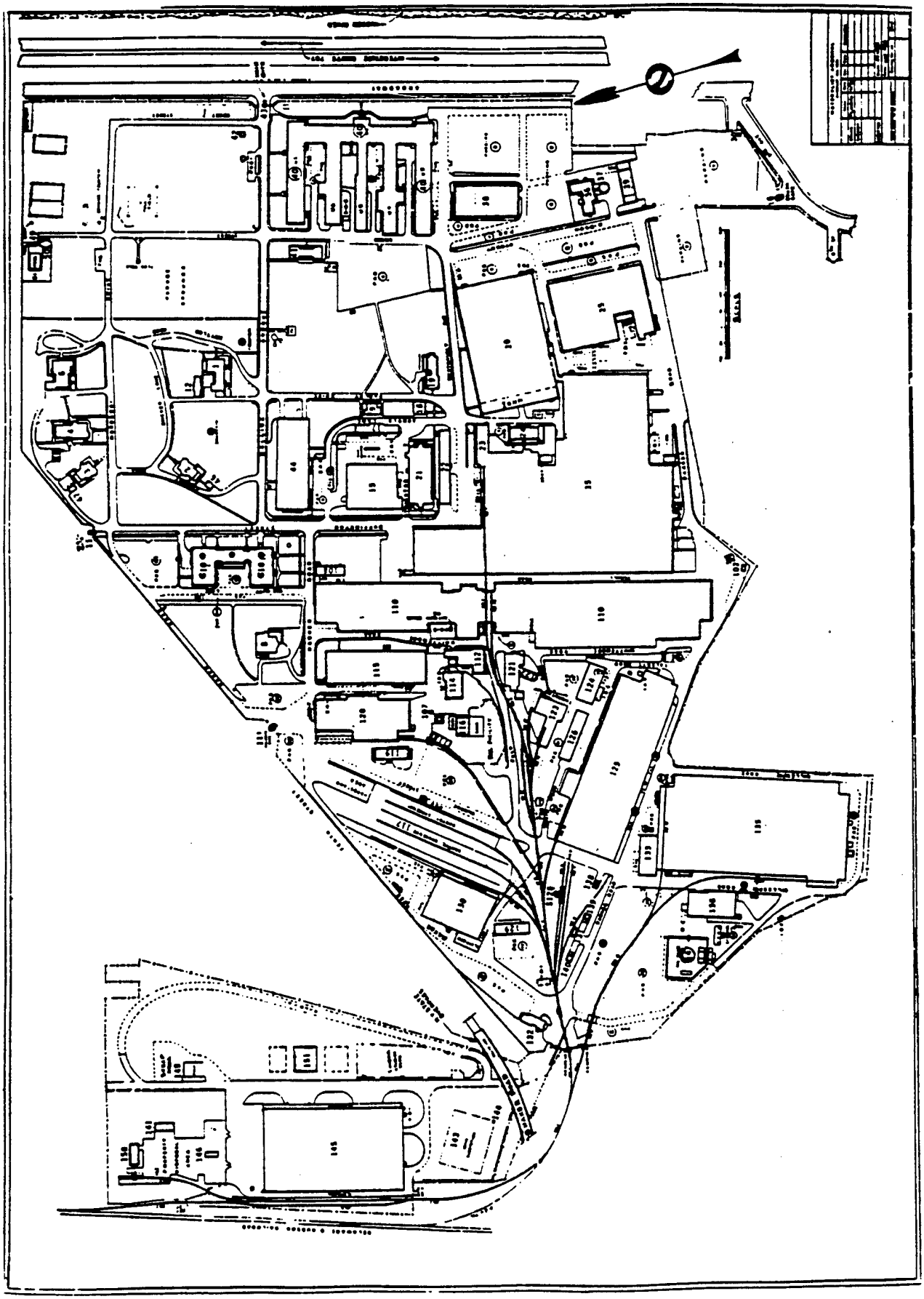


Figure 2-1
Watervliet Arsenal Site Map

Watervliet Arsenal

Basic Process Flow Diagram

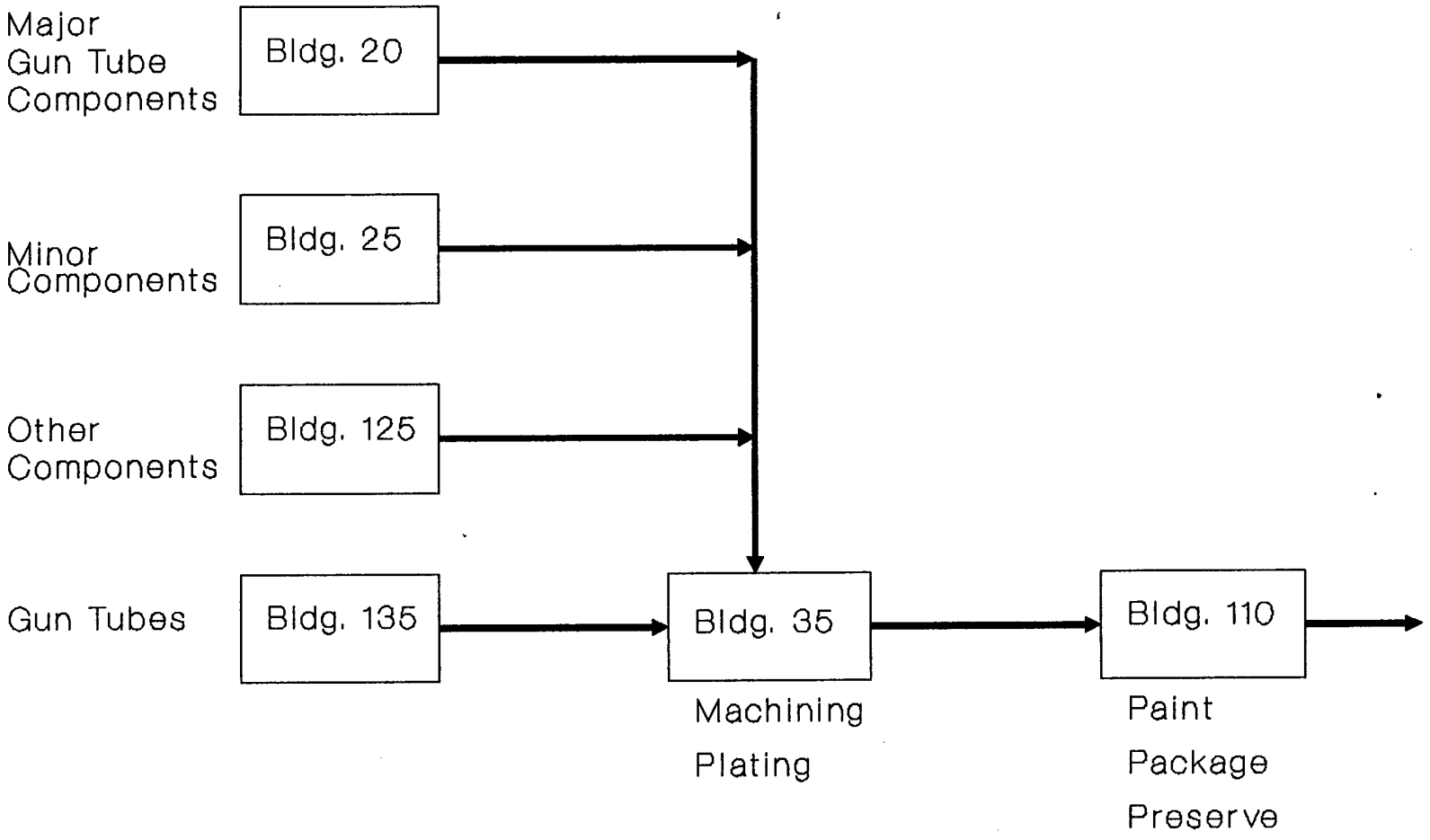


Figure 2-2

3.0 ENERGY CONSUMPTION

3.1 Energy Use

Total facility and production energy consumption at WVA increased by approximately 3.6 percent from FY 85 through FY 91 (Figure 3-1). The cause for the increase was because of increases in the use of electricity and natural gas which increased 8.5 percent and 45 percent, respectively. Residual fuel oil and distillate consumption decreased 5.0 percent and 70 percent.

Monthly consumption of heating fuels and electricity for FY 91 is shown in Figure 3-2. The strong dependence of heating fuels on weather is readily apparent, although some steam is generated during the summer months for uses other than space heating (metal plating in Building 35). Electricity use is fairly constant throughout the year, showing that almost all electricity consumption is strictly production related.

Percentages of fuel use for FY 91 are shown in Figure 3-3 . The heating fuels accounted for approximately 68 percent of energy use in that year.

3.2 Costs

Total annual energy costs at WVA were unusually high in FY 91, about 33 percent over the FY 85 values (Figure 3-4). The changes in costs reflect changes in unit pricing over the same time period (Figure 3-5). The main reason for the increase was the large increase in fuel oil costs due to the impact of Desert Shield in late summer 1991. Iraq occupation of Kuwait caused oil prices to skyrocket. Unfortunately, this was in the same time period that the Army negotiated its annual fuel oil contracts four all CONUS installations.

Monthly energy costs at WVA are shown in Figure 3-6. As in the case of consumption, boiler fuel costs vary widely, depending on weather. Electricity costs are a significant portion of the monthly costs, and can range from 55 percent of the monthly total to 90+ percent.

Electricity costs dominate the total annual energy bill because of the higher unit price. In FY 91, even with the unusually high fuel oil prices, electricity costs represented over 60 percent of the total expense of $6,024,000 (Figure 3-7).

Watervliet Arsenal
Historical Energy Use

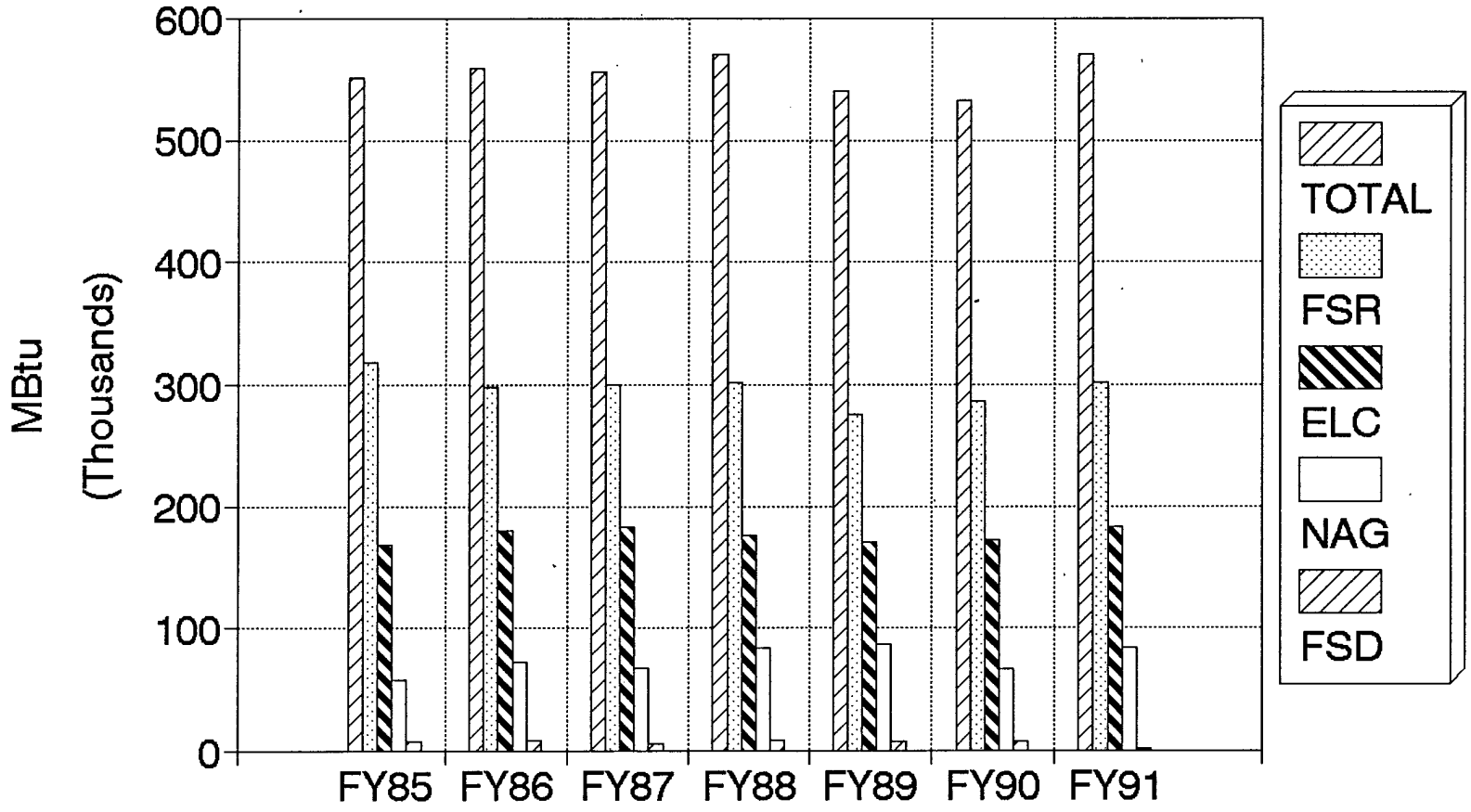


Figure 3-1

Watervliet Arsenal
FY91 Energy Use By Fuel

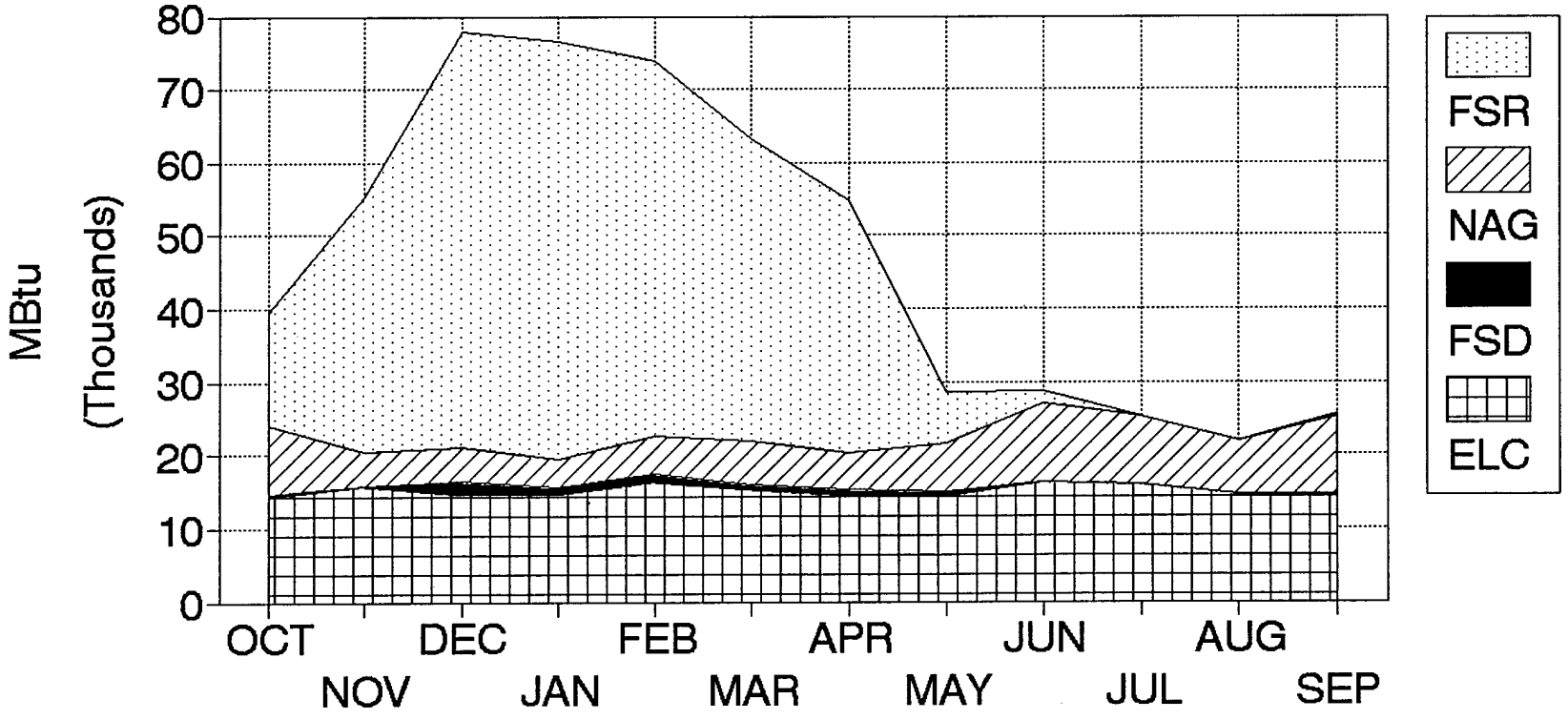
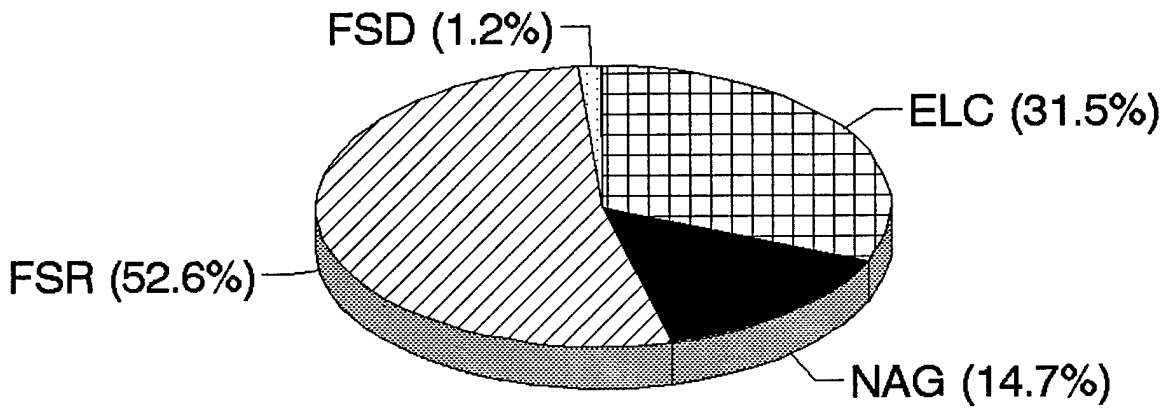


Figure 3-2

Watervliet Arsenal
FY91 Facility Energy Use



Total Use = 571,000 MBtu

Figure 3-3

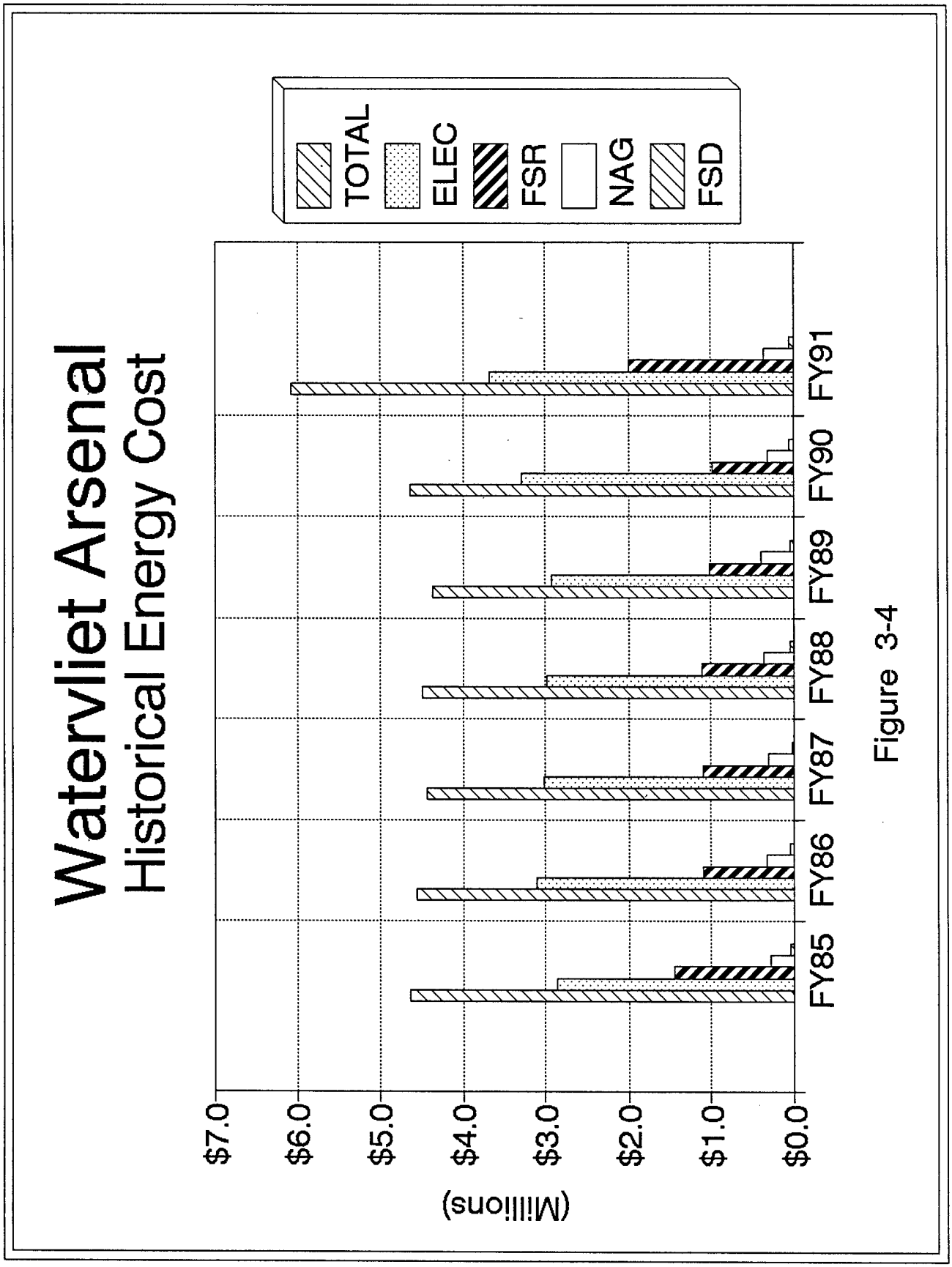

Watervliet Arsenal
Historical Energy Cost
TOTAL
ELEC
FSR
NAG
FSD
(Millions)
$7.0
$6.0
$5.0
$4.0
$3.0
$2.0
$1.0
$0.0
FY85
FY86
FY87
FY88
FY89
FY90
FY91

Figure 3-4

Watervliet Arsenal
Historical Energy Unit Cost

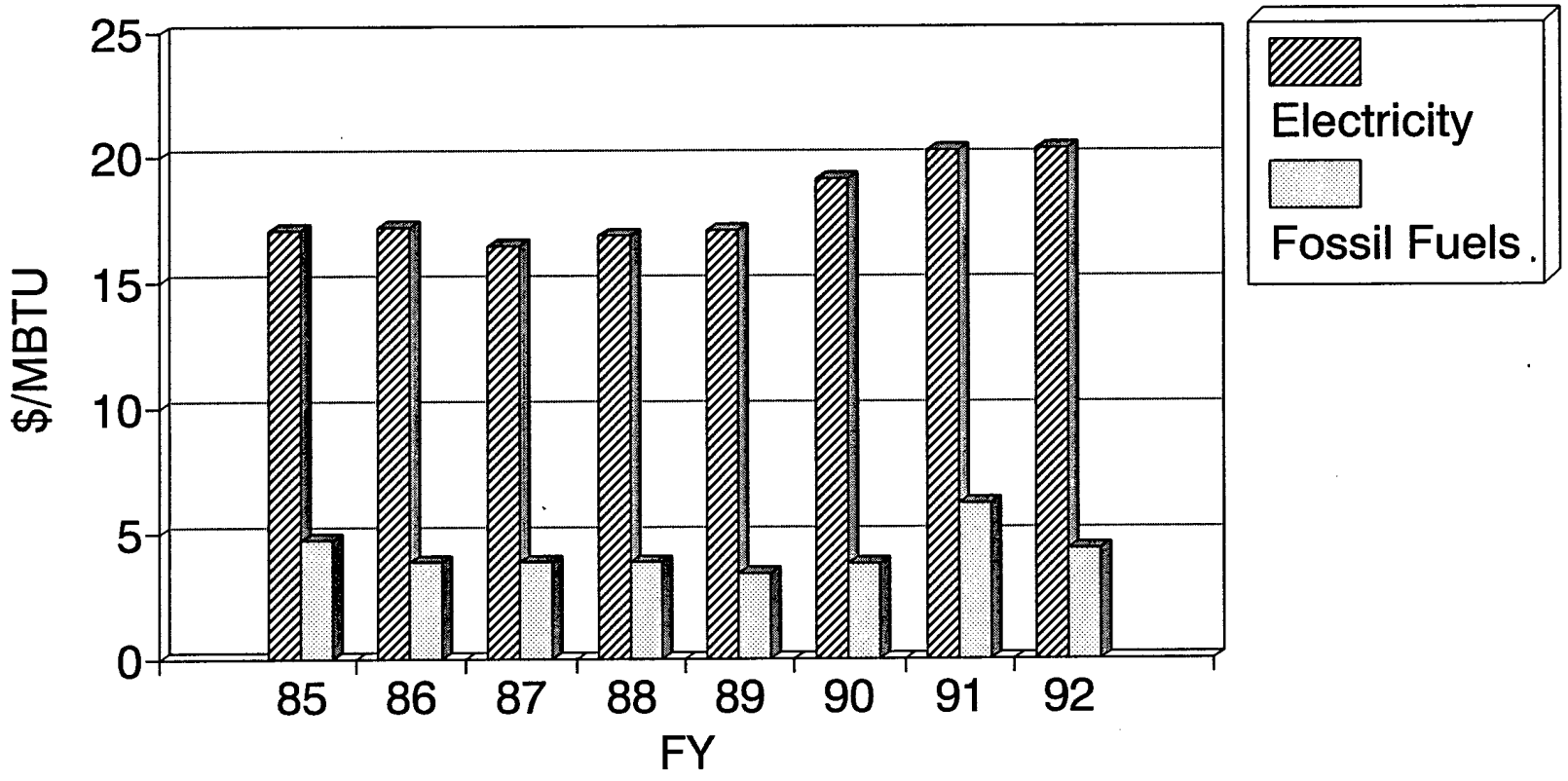


Figure 3-5

Watervliet Arsenal

FY91 Energy Cost By Fuel

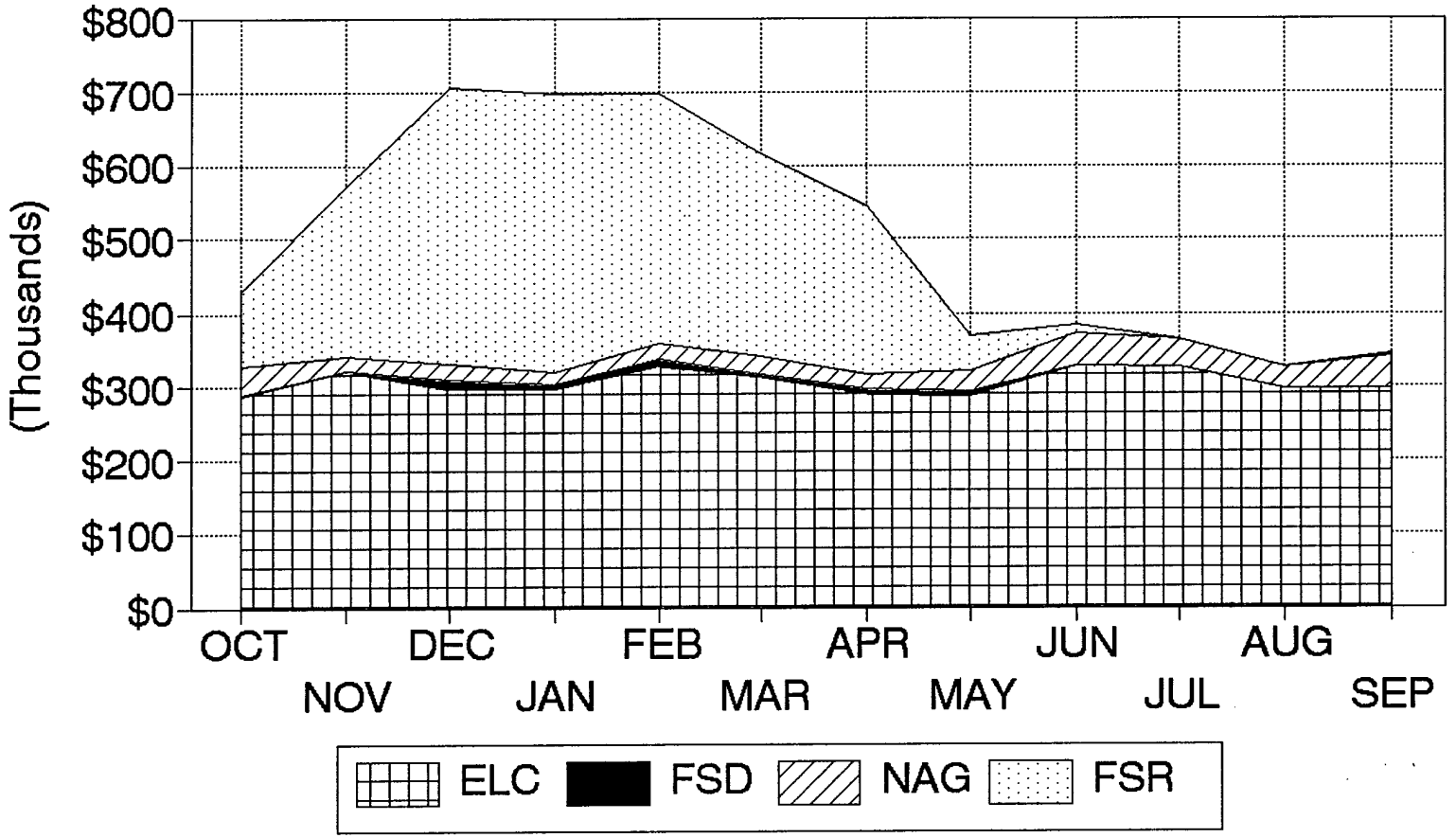
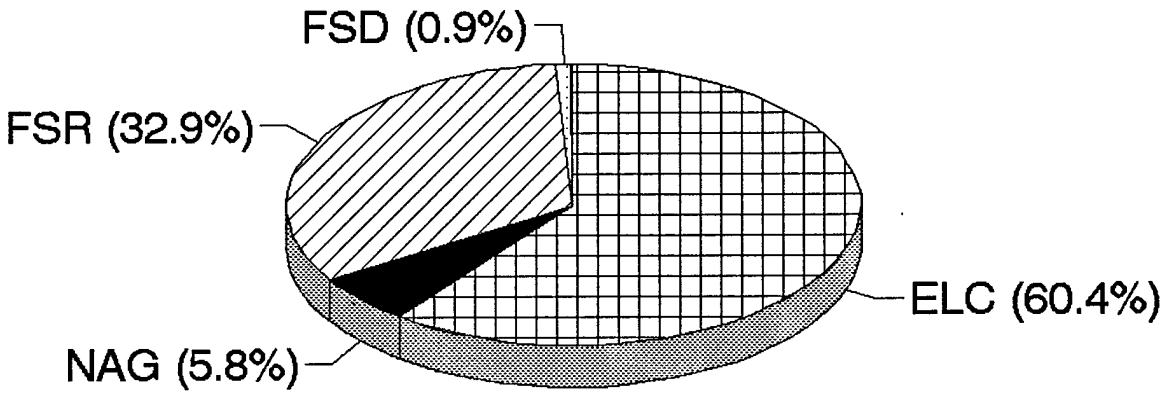


Figure 3-6

Watervliet Arsenal
FY91 Facility Energy Cost



Total Cost = $ 6,024,000

Figure 3-7

4.0 ENERGY ANALYSIS

4.1 Energy Conservation Opportunity (ECO) Evaluations

Each of the ECOs listed in the Scope of Work plus others were reviewed for their applicability and potential for significant energy savings and cost effectiveness for buildings representative of high energy consumption process areas at WVA. The results of this assessment are contained in tables in Appendix B.

For each of the ECOs that were chosen to be evaluated, energy savings were calculated, cost estimates made and Life Cycle Cost Analyses performed. A summary of the results are contained in Tables 4-1 and 4-2. The evaluated ECOs are described and listed in Table 4-1. An alphabetical listing of evaluated ECOs along with a summary of the energy and cost savings analysis is shown in Table 4-2. Table 4-3 contains a listing prioritized by SIR. Table 4-4 contains a list prioritized by simple payback. Backup data and calculations are contained in Appendix B.

Table 4-1. ECOs Evaluated--Titles

ECO #	Description
1	Power factor improvement
2	Natural gas fuel switch at the main boiler plant
3	Cogeneration
4	Dip tank covers with exhaust fan motor variable-speed drives
5	Electrical demand peak reduction
6	Plating area condensate return system
7	Condenser fan variable speed drives
8	High-efficiency fluorescent lighting and ballasts
9	Not used
10	High-efficiency electric motors
11	Boiler O_2 trim controls
12	Natural gas boilers
13	Reduce HVAC system air flow
14	High-efficiency chiller
15	EMCS
16	Return air system
17	Double pane windows
18	Storm windows
19	Occupancy sensors

Table 4-2. ECO Evaluations - Results

No.	ECO #	Project Name	Construction Cost Plus SIOH	Savings (Increase), MBtu/Year				Net Annual Cost Savings	SIR	Simple Payback (yrs)
				Elec	Dist	Resid	N Gas			
1	1	Power Factor Improvement	$138,786	0	0	0	0	$31,000	3.1	4.7
2	2	Natural Gas Fuel Switch	$364,051	0	0	278,000	(278,000)	$66,700	4.4	5.8
3	3	Cogeneration	$1,303,232	0	0	28,400	(77,700)	$140,500	1.0	9.8
4	4	Dip Tank Covers & VSDs	$202,576	2,707	0	21,650	0	$141,900	11.6	1.5
5	5	Elec. Demand Peak Reduction	$0	0	0	0	0	$151,000	∞	0
6	6	Condensate Return	$16,712	0	0	2,255	3,205	$23,300	24.1	0.8
7	7	Condenser Fan VSDs	--	--	--	--	--	--	--	--
8	8A	34 W FL-Prod	$2,065	51	0	0	0	$970	6.8	2.2
9	8B	34 W FL&EB-Prod	$12,299	102	0	0	0	$2,000	2.6	6.1
10	8C	T8 FL&EB-Prod	$10,490	117	0	0	0	$2,400	3.3	4.7
11	8D	34W FL-NonProd	$52,591	589	0	0	0	$11,300	3.1	4.9
12	8E	34W FL&EB-NonProd	$316,753	1,104	0	0	0	$24,900	1.3	13.4
13	8F	T8 FL&EB-NonProd	$361,167	1,399	0	0	0	$30,600	1.3	12.5
14	8G	60W FL-Prod	$64,691	768	0	0	0	$13,200	3.0	5.2
15	8H	60W FL-Prod	$367,198	4,478	0	0	0	$91,200	3.6	4.3
16	8I	60W FL-NonProd	$108,685	58	0	0	0	$15,500	1.4	11.2
17	8J	60W FL&EB-NonProd	$60,651	339	0	0	0	$7,100	1.7	9.0
18	9	Not Used	--	--	0	0	0	--	--	--
19	10	High-Efficiency Motors	$111,227	1,602	0	0	0	$32,600	4.2	3.6
20	11	Boiler O2 Trim Controls	--	--	--		--	--	--	--
21	12	Natural Gas Boilers	$47,268	2,497	0	0	(3,122)	$37,800	10.7	1.3
22	13	Air Flow Reduction	$969	31	0	25	0	$740	11.4	1.4
23	14	High-Efficiency Chiller	$141,184	363	0	0	0	$7,400	0.8	20.2
24	15	EMCS	$522,900	0	0	9,851	0	$49,600	1.1	11.2
25	16	Return Air System	$66,495	0	0	3,985	0	$17,500	4.6	4.0
26	17	Double-Pane Wind. (1)	$495	0.02	0	2.55	0	$12	0.4	45.9
27	18	Storm Windows (1)	$107	0.02	0	2.55	0	$11	1.8	10.5
28	19	Occupancy Sensors	$11,976	211	0	0	0	$4,600	5.5	2.8

Note : VSD = Variable speed drive
FL = Fluorescents
EB = Electronic ballasts
Prod = Production areas
NonProd = Non-production areas
T8 = T8 fluorescents
(1) Per unit basis

Table 4-3. ECO Evaluations - Results Prioritized by SIR

No.	ECO #	Project Name	Construction Cost Plus SIOH	Savings (Increase), MBtu/Year Elec	Dist	Resid	N Gas	Net Annual Cost Savings	SIR	Simple Payback (yrs)
1	5	Elec. Demand Peak Reduction	$0	0	0	0	0	$151,000	∞	0
2	6	Condensate Return	$16,712	0	0	2,255	3,205	$23,300	24.1	0.8
3	4	Dip Tank Covers & VSDs	$202,576	2,707	0	21,650	0	$141,900	11.6	1.5
4	13	Air Flow Reduction	$969	31	0	25	0	$740	11.4	1.4
5	12	Natural Gas Boilers	$47,268	2,497	0	0	(3,122)	$37,800	10.7	1.3
6	8A	34 W FL-Prod	$2,065	51	0	0	0	$970	6.8	2.2
7	19	Occupancy Sensors	$11,976	211	0	0	0	$4,600	5.5	2.8
8	16	Return Air System	$66,495	0	0	3,985	0	$17,500	4.6	4.0
9	2	Natural Gas Fuel Switch	$364,051	0	0	278,000	(278,000)	$66,700	4.4	5.8
10	10	High-Efficiency Motors	$111,227	1,602	0	0	0	$32,600	4.2	3.6
11	8H	60W FL-Prod	$367,198	4,478	0	0	0	$91,200	3.6	4.3
12	8C	T8 FL&EB-Prod	$10,490	117	0	0	0	$2,400	3.3	4.7
13	8D	34W FL-NonProd	$52,591	589	0	0	0	$11,300	3.1	4.9
14	1	Power Factor Improvement	$138,786	0	0	0	0	$31,000	3.1	4.7
15	8G	60W FL-Prod	$64,691	768	0	0	0	$13,200	3.0	5.2
16	8B	34 W FL&EB-Prod	$12,299	102	0	0	0	$2,000	2.6	6.1
17	18	Storm Windows (1)	$107	0.02	0	2.55	0	$11	1.8	10.5
18	8J	60W FL&EB-NonProd	$60,651	339	0	0	0	$7,100	1.7	9.0
19	8I	60W FL-NonProd	$108,685	58	0	0	0	$15,500	1.4	11.2
20	8E	34W FL&EB-NonProd	$316,753	1,104	0	0	0	$24,900	1.3	13.4
21	8F	T8 FL&EB-NonProd	$361,167	1,399	0	0	0	$30,600	1.3	12.5
22	15	EMCS	$522,900	0	0	9,851	0	$49,600	1.1	11.2
23	3	Cogeneration	$1,303,232	0	0	28,400	(77,700)	$140,500	1.0	9.8
24	14	High-Efficiency Chiller	$141,184	363	0	0	0	$7,400	0.8	20.2
25	17	Double-Pane Wind. (1)	$495	0.02	0	2.55	0	$12	0.4	45.9
26	11	Boiler O2 Trim Controls	--	--	--	--	--	--	--	--
27	9	Not Used	--	--	0	0	0	--	--	--
28	7	Condenser Fan VSDs	--	--	--	--	--	--	--	--

Note : VSD = Variable speed drive
FL = Fluorescents
EB = Electronic ballasts
Prod = Production areas
NonProd = Non-production areas
T8 = T8 fluorescents
(1) Per unit basis

Table 4-4. ECO Evaluations - Results Prioritized by Simple Payback

No.	ECO #	Project Name	Construction Cost Plus SIOH	Savings (Increase), MBtu/Year Elec	Dist	Resid	N Gas	Net Annual Cost Savings	SIR	Simple Payback (yrs)
1	5	Elec. Demand Peak Reduction	$0	0	0	0	0	$151,000	∞	0.0
2	6	Condensate Return	$16,712	0	0	2,255	3,205	$23,300	24.1	0.8
3	12	Natural Gas Boilers	$47,268	2,497	0	0	(3,122)	$37,800	10.7	1.3
4	13	Air Flow Reduction	$969	31	0	25	0	$740	11.4	1.4
5	4	Dip Tank Covers & VSDs	$202,576	2,707	0	21,650	0	$141,900	11.6	1.5
6	8A	34 W FL-Prod	$2,065	51	0	0	0	$970	6.8	2.2
7	19	Occupancy Sensors	$11,976	211	0	0	0	$4,600	5.5	2.8
8	10	High-Efficiency Motors	$111,227	1,602	0	0	0	$32,600	4.2	3.6
9	16	Return Air System	$66,495	0	0	3,985	0	$17,500	4.6	4.0
10	8H	60W FL-Prod	$367,198	4,478	0	0	0	$91,200	3.6	4.3
11	1	Power Factor Improvement	$138,786	0	0	0	0	$31,000	3.1	4.7
12	8C	T8 FL&EB-Prod	$10,490	117	0	0	0	$2,400	3.3	4.7
13	8D	34W FL-NonProd	$52,591	589	0	0	0	$11,300	3.1	4.9
14	8G	60W FL-Prod	$64,691	768	0	0	0	$13,200	3.0	5.2
15	2	Natural Gas Fuel Switch	$364,051	0	0	278,000	(278,000)	$66,700	4.4	5.8
16	8B	34 W FL&EB-Prod	$12,299	102	0	0	0	$2,000	2.6	6.1
17	8J	60W FL&EB-NonProd	$60,651	339	0	0	0	$7,100	1.7	9.0
18	3	Cogeneration	$1,303,232	0	0	28,400	(77,700)	$140,500	1.0	9.8
19	18	Storm Windows (1)	$107	0.02	0	2.55	0	$11	1.8	10.5
20	8I	60W FL-NonProd	$108,685	58	0	0	0	$15,500	1.4	11.2
21	15	EMCS	$522,900	0	0	9,851	0	$49,600	1.1	11.2
22	8F	T8 FL&EB-NonProd	$361,167	1,399	0	0	0	$30,600	1.3	12.5
23	8E	34W FL&EB-NonProd	$316,753	1,104	0	0	0	$24,900	1.3	13.4
24	14	High-Efficiency Chiller	$141,184	363	0	0	0	$7,400	0.8	20.2
25	17	Double-Pane Wind. (1)	$495	0.02	0	2.55	0	$12	0.4	45.9
26	11	Boiler O2 Trim Controls	--	--	--	--	--	--	--	--
27	9	Not Used	--	--	0	0	0	--	--	--
28	7	Condenser Fan VSDs	--	--	--	--	--	--	--	--

Note : VSD = Variable speed drive
FL = Fluorescents
EB = Electronic ballasts
Prod = Production areas
NonProd = Non-production areas
T8 = T8 fluorescents
(1) Per unit basis

4.2 Multiple ECO Project Evaluations

ECIP Number 1. ECOs 8A through 8J represent a variety of measures for saving energy using high-efficiency fluorescent lamps and fixtures. There are three basic combinations evaluated for replacement:

- Four-foot fluorescents in production areas
- Four-foot fluorescents in non-production areas
- Eight-foot fluorescents in production areas

ECOs 8C, 8D and 8H were selected based on the life cycle cost analysis and combined into a single Energy Conservation Investment Program (ECIP) project.

4.3 Operations and Maintenance Energy Savings

4.3.1 Energy Savings Ideas. As a result of the site visit to WVA, several operations and maintenance (O&M) energy savings ideas were identified. Energy and economic analyses were performed for these recommendations. The results of these analyses are presented below. Calculations for energy savings can be found in Volume II, Appendix B, under O&M Recommendations.

Upon Failure, Replace Standard Fluorescent Lamps with Energy-Efficient Types

Current practice is to replace failed fluorescent lamps with standard 40-watt lamps. Replacing failed lamps with 34-watt lamps saves about $0.95 per year for each lamp in office areas and $3.40 in production buildings. The incremental cost is the difference between the cost of the two lamps, which is $0.81 per lamp. This yields a payback of about 0.9 years for administrative areas and 0.25 for production.

Upon Failure, Replace Standard Fluorescent Fixture Ballasts with Energy-Efficient Types

Currently, fluorescent fixtures at Watervliet Arsenal use standard-efficiency ballasts. When a failure occurs, the standard ballast should be replaced with an electronic ballast. Energy savings for two lamp fixtures are 25 watts for four-foot models and 45 watts for the eight-foot type. Paybacks vary from 0.4 years in production areas to about 1.2 years in non-production.

Increase Boiler Condensate Return

A review of boiler logs shows that the condensate return for the main boiler plant averages about 60 percent. During our site surveys, a number of steam leaks and failed traps were found that can account for much of this. Locations are listed below and were identified by WVA maintenance personnel.

Buildings	Location
44	Mechanical room
34	Roof vent
40	Vent from wing near clinic
35	Roof--southwest corner
35	Exterior well south-middle
88	Roof vent--northwest corner

110	Roof vent--northwest side
110	Roof vent--southeast side
110	Roof vent--west middle
20	Roof vent--south side

Improving the condensate return to 90 percent is an achievable goal. This would require an increase in staffing at least on a temporary basis or utilizing a contractor. Annual savings of 7,100 MBtu of fuel oil costing $47,000 could be realized.

Repair Compressed Air Leaks

Throughout the production buildings, compressed air leaks were found. Generally, the leaks occur at fittings or filters. Also, many hose attachments have been made using screw-clamps. These are not recommended as they have a tendency to cut into the hose which is carrying 100 psi air. Many leaks and clamps were identified by WVA maintenance personnel. Repairing one compressed air leak saves about 6,300 kWh (22 MBtu) of electricity each year costing $440.

5.0 ENERGY PLAN

5.1 Project Packaging

The ECOs listed in Table 4-2 were evaluated for appropriate funding category. The project scope of work listed the following guidelines on this subject.

	Project Cost	Simple Payback
QRIP	$5,000-$100,000	≤ 2 yrs.
OSD PIF	> $100,000	≤ 4 yrs.
PECIP	> $100,000	≤ 4 yrs.
ECIP	> $200,000	≤ 10 yrs., SIR > 1.0
MCA	> $200,000	≤ 25 yrs., ≥ 8 yrs.

DA Form 1391 is required only for those ECIP and MCA projects costing greater than $200,000. Otherwise, DA Form 5108-R from AR 5-4 is used.

Table 5-1 contains the results of the analysis with the project funding category listed in the far right column and is summarized in Table 5-2. Table 5-3 lists the ECOs by project funding category.

Three projects, ECO 13, Reduce Air Flow; ECO 16, Return Air System; and ECO 19, Occupancy Sensor have paybacks less than four years, but do not meet the project cost minimum. Projects 8C, 8D and 8H are being funded in favor of 8A, 8B, 8E, 8F and 8G. ECO 2, Natural Gas Switch, qualifies for ECIP funds, but is likely to be funded by Niagara-Mohawk Power Company. Cogeneration, ECO 3, qualifies for ECIP funding, but requires further study due to the large cost, $1.3 million. It also requires the natural gas line to be completed to the main boiler plant (ECO 2). Project 15, EMCS, does not meet ECIP requirements, but could be funded under MCA.

5.2 Energy and Cost Savings

Energy and cost savings for the recommended project funding are listed in Table 5-4. Project capital costs are escalated at 4 percent per year according to the project implementation schedule as discussed below. Energy costs are in constant dollars using FY 92 prices. The implementation of all projects yield a total annual energy savings of 45,900 MBtu and annual cost

Table 5-1. ECO Evaluations - Project Funding - Prioritized by Simple Payback

No.	ECO #	Project Name	Construction Cost Plus SIOH	Savings (Increase), MBtu/Year Elec	Dist	Resid	N Gas	Net Annual Cost Savings	SIR	Simple Payback (yrs)	Project Funding
1	5	Elec. Demand Peak Reduction	$0	0	0	0	0	$151,000	∞	0	
2	6	Condensate Return	$16,712	0	0	2,255	3,205	$23,300	24.1	0.8	QRIP
3	12	Natural Gas Boilers	$47,268	2,497	0	0	(3,122)	$37,800	10.7	1.3	QRIP
4	13	Air Flow Reduction	$969	31	0	25	0	$740	11.4	1.4	NF
5	4	Dip Tank Covers & VSDs	$202,576	2,707	0	21,650	0	$141,900	11.6	1.5	OSD PIF
6	8A	34 W FL-Prod	$2,065	51	0	0	0	$970	6.8	2.2	NF
7	19	Occupancy Sensors	$11,976	211	0	0	0	$4,600	5.5	2.8	NF
8	10	High-Efficiency Motors	$111,227	1,602	0	0	0	$32,600	4.2	3.6	OSD PIF
9	16	Return Air System	$66,495	0	0	3,985	0	$17,500	4.6	4.0	NF
10	8H	60W FL-Prod	$367,198	4,478	0	0	0	$91,200	3.6	4.3	ECIP (2)
11	8C	T8 FL&EB-Prod	$10,490	117	0	0	0	$2,400	3.3	4.7	ECIP (2)
12	1	Power Factor Improvement	$138,786	0	0	0	0	$31,000	3.1	4.7	NF
13	8D	34W FL-NonProd	$52,591	589	0	0	0	$11,300	3.1	4.9	ECIP (2)
14	8G	60W FL-Prod	$64,691	768	0	0	0	$13,200	3.0	5.2	NF
15	2	Natural Gas Fuel Switch	$364,051	0	0	278,000	(278,000)	$66,700	4.4	5.8	NF
16	8B	34 W FL&EB-Prod	$12,299	102	0	0	0	$2,000	2.6	6.1	NF
17	8J	60W FL&EB-NonProd	$60,651	339	0	0	0	$7,100	1.7	9.0	NF
18	3	Cogeneration	$1,303,232	0	0	28,400	(77,700)	$140,500	1.0	9.8	NF
19	18	Storm Windows (1)	$107	0.02	0	2.55	0	$11	1.8	10.5	NF
20	8I	60W FL-NonProd	$108,685	58	0	0	0	$15,500	1.4	11.2	NF
21	15	EMCS	$522,900	0	0	9,851	0	$49,600	1.1	11.2	MCA
22	8F	T8 FL&EB-NonProd	$361,167	1,399	0	0	0	$30,600	1.3	12.5	NF
23	8E	34W FL&EB-NonProd	$316,753	1,104	0	0	0	$24,900	1.3	13.4	NF
24	14	High-Efficiency Chiller	$141,184	363	0	0	0	$7,400	0.8	20.2	NR
25	17	Double-Pane Wind. (1)	$495	0.02	0	2.55	0	$12	0.5	45.9	NR
26	9	Not Used	--	--	0	0	0	--	--	--	--
27	11	Boiler O2 Trim Controls	--	--	--	--	--	--	--	--	--
28	7	Condenser Fan VSDs	--	--	--	--	--	--	--	--	--

Note : VSD = Variable speed drive
FL = Fluorescents
EB = Electronic ballasts
Prod = Production areas
NonProd = Non-production areas
NF = Does not meet funding requirements
NR = Not recommended
T8 = T8 fluorescent
(1) Per unit basis
(2) Combined into a single ECIP

Table 5-2. ECO Evaluations - Project Funding Summary - Grouped by Funding Category

No.	ECO #	Title: ECO Names	Construction Cost Plus SIOH	SIR	Simple Payback (yrs)	Project Funding
1	5	Elec. Demand Peak Reduction	$0	∞	0	--
2	6	Condensate Return	$16,712	24.1	0.8	QRIP
3	12	Natural Gas Boilers	$47,268	10.7	1.3	QRIP
4	4	Dip Tank Covers & VSDs	$202,576	11.6	1.5	OSD PIF
5	10	High-Efficiency Motors	$111,227	4.2	3.6	OSD PIF
6	8C	T8 FL&EB-Prod	$10,490	3.3	4.7	ECIP (1)
7	8D	34W FL-NonProd	$52,591	3.1	4.9	ECIP (1)
8	8H	60W FL-Prod	$367,198	3.6	4.3	ECIP (1)
9	15	EMCS	$522,900	1.1	11.2	MCA
10	1	Power Factor Improvement	$138,786	3.1	4.7	NF
11	2	Natural Gas Fuel Switch	$364,051	4.4	5.8	NF
12	3	Cogeneration	$1,303,232	1.0	9.8	NF
13	8A	34 W FL-Prod	$2,065	6.8	2.2	NF
14	8B	34 W FL&EB-Prod	$12,299	2.6	6.1	NF
15	8E	34W FL&EB-NonProd	$316,753	1.3	13.4	NF
16	8F	T8 FL&EB-NonProd	$361,167	1.3	12.5	NF
17	8G	60W FL-Prod	$64,691	3.0	5.2	NF
18	8I	60W FL-NonProd	$108,685	1.4	11.2	NF
19	8J	60W FL&EB-NonProd	$60,651	1.7	9.0	NF
20	13	Air Flow Reduction	$969	11.4	1.4	NF
21	16	Return Air System	$66,495	4.6	4.0	NF
22	19	Occupancy Sensors	$11,976	5.5	2.8	NF
23	18	Storm Windows (2)	$107	1.8	10.5	NF

Note : VSD = Variable speed drive
FL = Fluorescents
EB = Electronic ballasts
Prod = Production areas
NonProd = Non-production areas
NF = Does not meet funding requirements
NR = Not recommended
T8 = T8 fluorescents
(1) Combined into a single ECIP
(2) Per unit basis

Table 5-3. Project Funding List

Funds	ECO #	Project Description
QRIP	6	Condensate Return
	12	Natural Gas Boilers
OSD PIF	4	Dip Tank Covers and Variable-Speed Drive
	10	High-Efficiency Motors
ECIP	8	High-Efficiency Lighting
MCA	15	EMCS

Table 5-4. Energy and Cost Savings for Recommended Projects

#	Project Names	Construction Cost Plus SIOH (1)	Annual Energy Savings (MBtu/Yr)	Annual Energy Savings $(2)	Project Type	Year
5	Peak Demand Reduction	$0	0	$151,000	--	FY92
6	Condensate Return	$16,700	5,460	$23,300	QRIP	FY93
12	Natural Gas Boilers	$47,300	(625) (3)	$37,800	QRIP	FY93
4	Dip Tank Covers and VSDs	$202,600	24,357	$141,900	OSD PIF	FY93
10	High-Efficiency Motors	$111,200	1,602	$32,600	OSD PIF	FY93
8C, D, H	High-Efficiency Lighting	$430,300	5,184	$104,900	ECIP	FY96
15	EMCS	$522,900	9,851	$49,600	MCA	FY96
2	Natural Gas Fuel Switch	$364,100	0	$66,700	(4)	FY93
	TOTALS	$1,695,100	45,829	$607,800		

(1) Escalated to year of implementation.
(2) Energy costs are in constant FY92 dollars.
(3) Cost savings come from fuel switch from electricity to natural gas.
(4) Proposed to be funded by Niagara-Mohawk Power Corporation.

savings equal to $607,800, which represents a reduction of eight percent and ten percent, respectively in energy use and cost when compared to FY 91 values. Figures 5-1 through 5-4 show energy use and cost at WVA before and after implementation of these projects. Note that about $700,000 of the utility cost decrease is due to the large drop in the price of No. 6 fuel oil between FY 91 and FY 92.

5.3 Project Schedule

Project implementation dates are estimated as follows:

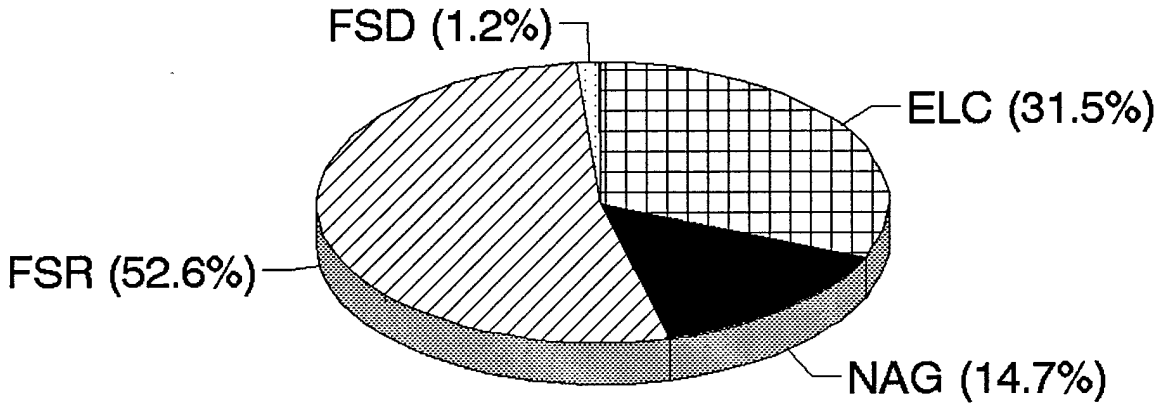
QRIP, OSD PIF	FY 93
ECIP, MCA	FY 96

Following this schedule, Figures 5-5 and 5-6 show how implementation of the recommended projects reduce energy use and cost, respectively, at WVA.

5.4 Environmental Impact

Another benefit of reducing energy use is the accompanying reduction in emissions from heating plants and electric utilities. Table 5-5 contains the results of an analysis performed using emission data collected from engineering periodicals and Niagara-Mohawk Power Corporation. When all projects are implemented, the reduction of emissions in the atmosphere are over 10,000 tons each year.

Watervliet Arsenal
FY91 Facility Energy Use

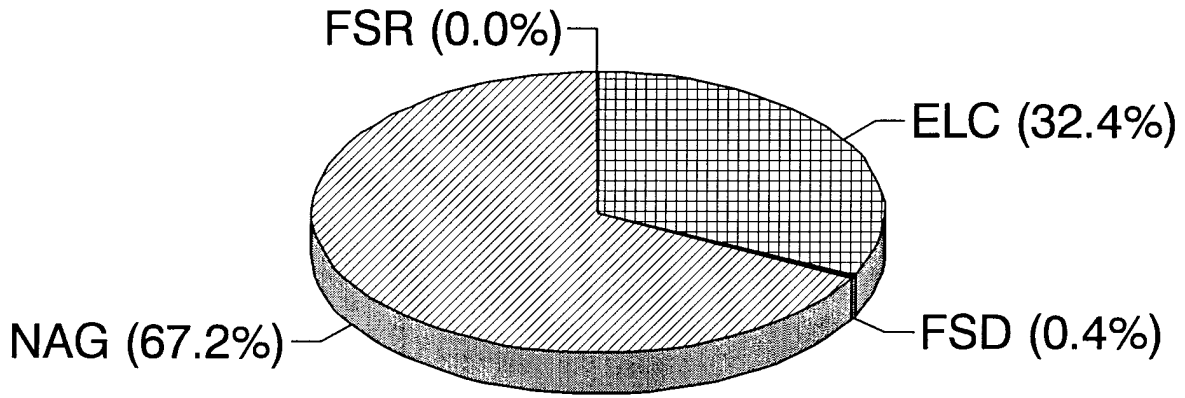


Total Use = 571,000 MBtu

Figure 5-1

Watervliet Arsenal

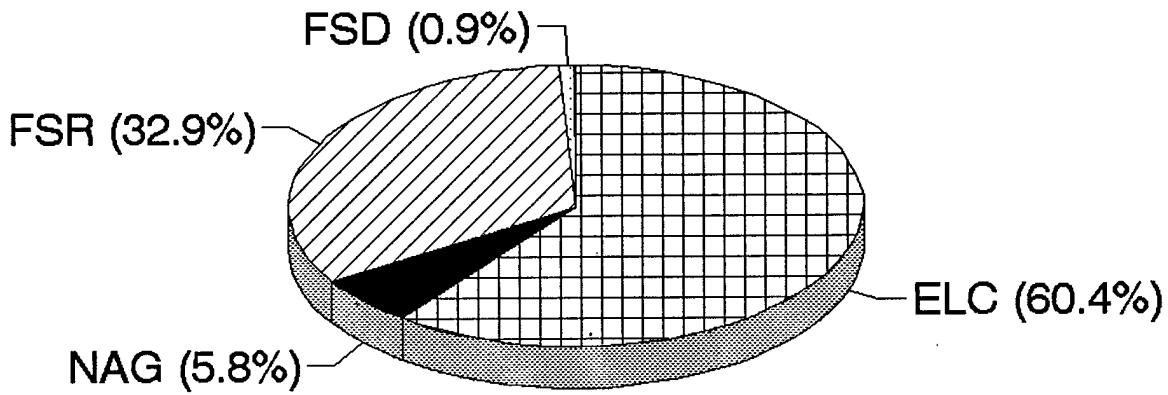
Energy Use After Project Implementation



Total Use = 525,000 MBtu

Figure 5-2

Watervliet Arsenal
FY91 Facility Energy Cost

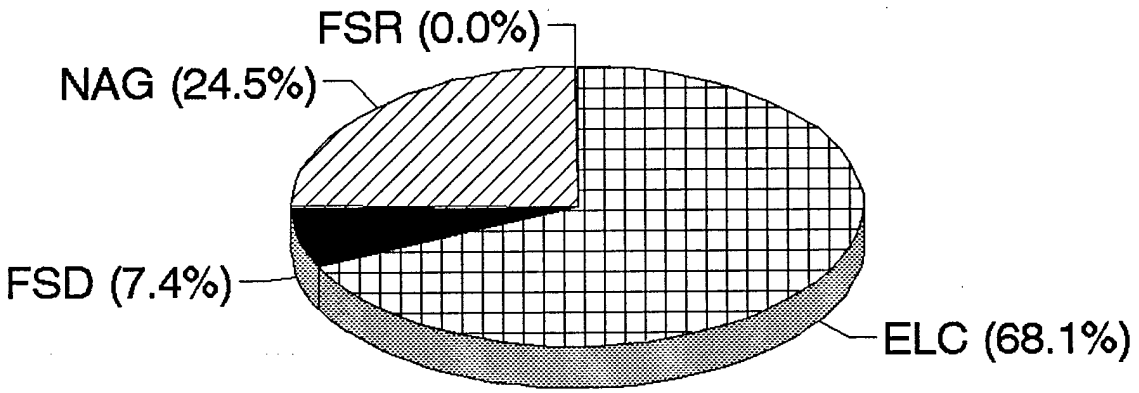


Total Cost = $ 6,024,000

Figure 5-3

Watervliet Arsenal

Energy Cost Aft. Project Implementation



Total Use = $ 4,700,000

Figure 5-4

Watervliet Arsenal

Effects of Energy Projects

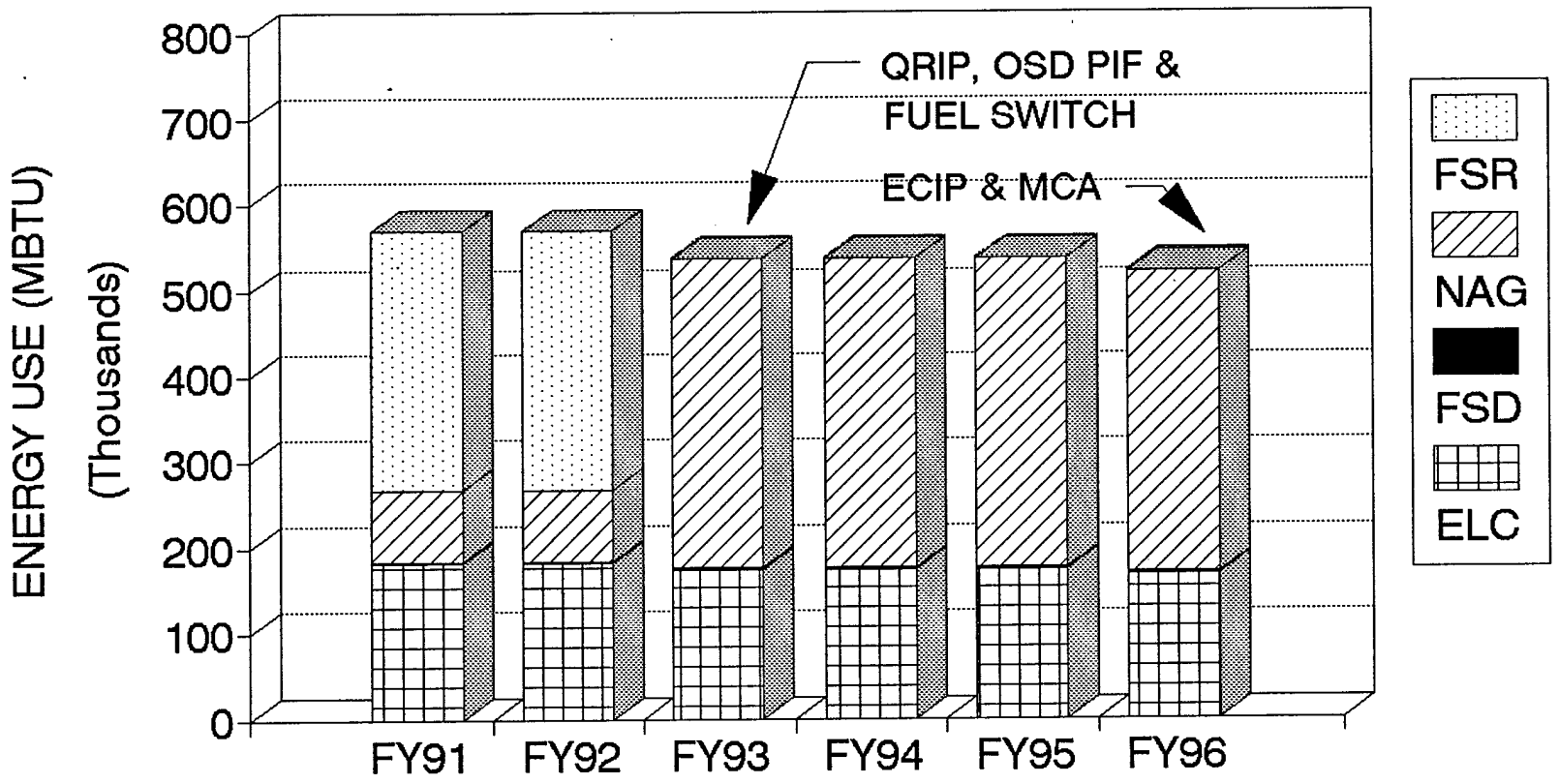


Figure 5-5

Watervliet Arsenal

Effects of Energy Projects

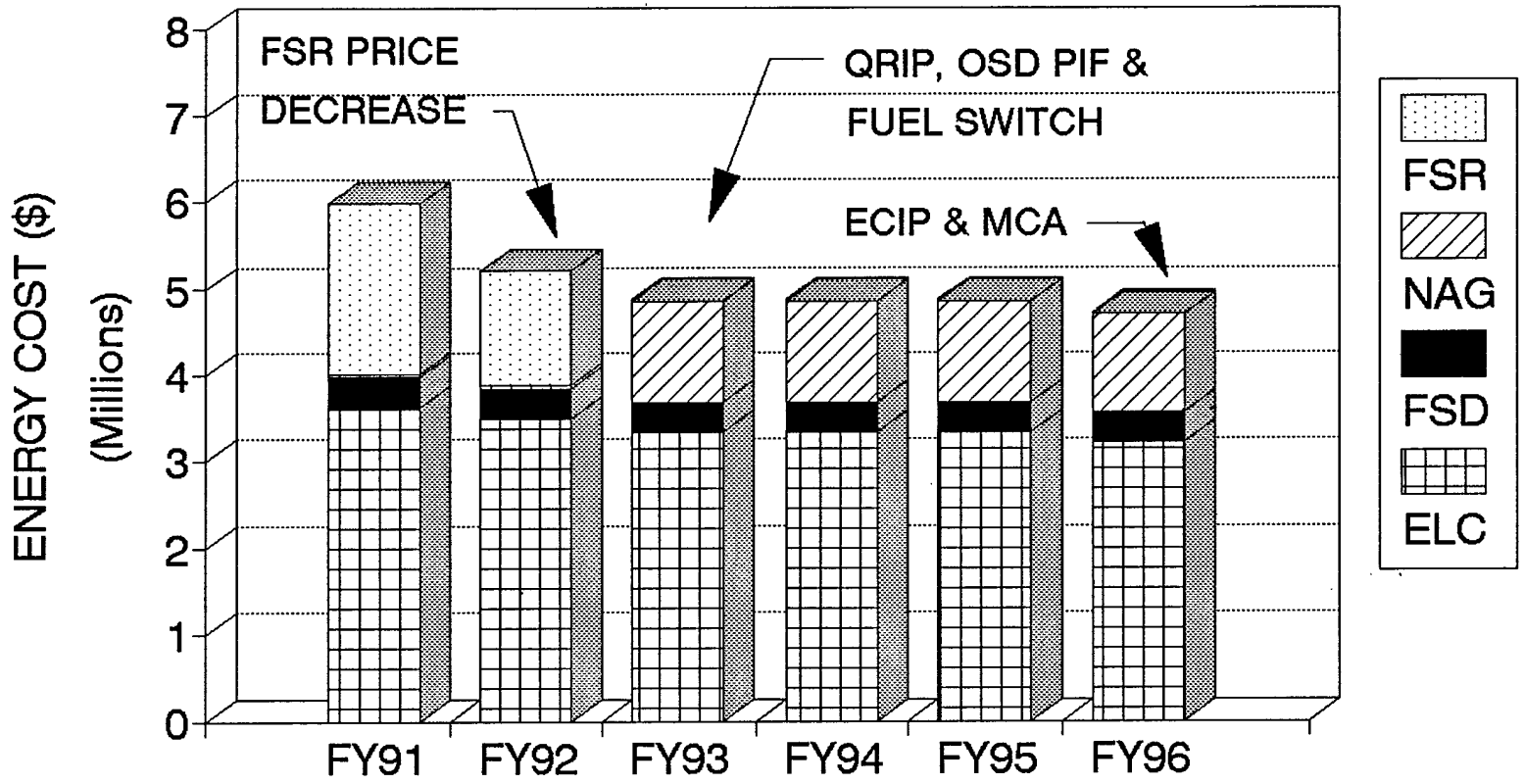


Figure 5-6

Table 5-5 Emission Reductions Due to Energy Saving Projects

ECO #	Project Name	Emissions (lbs/yr) SO2	NOx	Part.	CO2
6	Condensate Return	2,400	1,500	200	733,600
12	Natural Gas Boilers	8,800	700	700	871,100
4	Dip Tank Covers & VSDs	32,900	7,900	2,700	4,975,500
10	High Efficiency Motors	5,600	900	500	779,200
8C,D,H	High Efficiency Lighting	18,200	3,000	1,500	2,521,400
15	EMCS	10,600	2,900	900	1,664,800
5	Peak Demand Reduction	0	0	0	0
2	Natural Gas Fuel Switch	300,200	11,100	25,000	16,402,000
	TOTALS (lbs/yr)	378,700	28,000	31,500	27,947,600
	TOTALS (tons/yr)	200	14	16	14,000

SO2 - Sulfur Dioxide
NOx - Nitrogen Oxides
Part. - Particulates
CO2 - Carbon Dioxide